

18. Partial assessment of the skate stock complex in the Bering Sea and Aleutian Islands

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Executive Summary

The Bering Sea and Aleutian Islands (BSAI) skate complex is managed in aggregate, with a single set of harvest specifications applied to the entire complex. However, to generate the harvest recommendations the stock is divided into two units. Harvest recommendations for Alaska skate *Bathyrhaja parmifera*, the most abundant skate species in the BSAI, are made using the results of an age structured model and are managed under Tier 3. The remaining species (“other skates”) are managed under Tier 5 due to a lack of data. The Tier 3 and Tier 5 recommendations are combined to generate recommendations for the complex as a whole.

Beginning in 2017, groundfish stocks managed by the North Pacific Fishery Management Council are on a new assessment cycle. As was previously the case, full assessments for the BSAI skate complex will be conducted in even years when full survey data are available. In off years, the previous update format has been expanded to include more complete data regarding catch and biomass.

Summary of Changes in Assessment Inputs

Changes in the input data:

- 1) Catch data have been updated through October 26, 2019. The 2018 catch data used in the projection model have been updated, and new estimates of 2019 and 2020 catches were created for use in the projection model.
- 2) Survey biomass estimates from the 2019 eastern Bering Sea (EBS) shelf bottom trawl survey have been included.

Changes in assessment methodology:

- 1) There were no changes to the assessment methodology. The projection model for harvest recommendations was re-run with updated catch data.

Summary of results

- 1) The 2019 catch is on track to be substantially lower than during the 2011-2018 period, which saw catches increasing every year (Table 1).
- 2) The survey biomass estimate for the aggregate skate complex on the EBS shelf decreased slightly relative to 2018 (528, 826 t vs. 610,666 t; Figures 1-4).
- 3) The estimated EBS shelf biomass for Alaska skate (the most abundant species on the shelf) decreased slightly from 2016 (Tables 2 and 3; Figures 1 and 3). The northern Bering Sea (NBS) survey continues to encounter Alaska skate (Table 3 and Figure 2), with the biomass estimate for Alaska skate in the NBS increasing in 2019.

- 4) The estimated EBS shelf biomass for the Other Skate assemblage (all skates except for Alaska skate) decreased relative to 2018 and is similar to levels observed in 2015 and 2016 (Table 2; Figures 3 and 4). This was largely due to a reduced estimate of Aleutian skate biomass.
- 5) Exploitation rates for Alaska skate have risen slightly since 2015, however when the full catch data for 2019 are available it is likely that the 2019 values for all skates will drop substantially.
- 6) The harvest recommendations for 2020 have changed slightly from last year's assessment, and recommendations for 2021 are included.

Alaska skate harvest recommendations				
Quantity	As estimated or specified <i>last</i> year for:		As estimated or recommended <i>this</i> year for:	
	2019	2020	2020*	2021*
<i>M</i> (natural mortality rate)	0.13	0.13	0.13	0.13
Tier	3a	3a	3a	3a
Projected total (age 0+)	504,551	481,653	491,974	478,477
Female spawning biomass (t)				
Projected	115,957	114,010	117,973	114,985
<i>B</i> _{100%}	177,761	177,761	177,761	177,761
<i>B</i> _{40%}	71,105	71,105	71,105	71,105
<i>B</i> _{35%}	62,217	62,217	62,217	62,217
<i>F</i> _{OFL}	0.094	0.094	0.094	0.094
max <i>F</i> _{ABC}	0.081	0.081	0.081	0.081
<i>F</i> _{ABC}	0.081	0.081	0.081	0.081
OFL (t)	39,173	36,965	37,813	36,310
maxABC (t)	33,730	31,829	32,559	31,264
ABC (t)	33,730	31,829	32,559	31,264
Status	As determined <i>last</i> year for:		As determined <i>this</i> year for:	
	2017	2018	2018	2019
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

* The catch data used in the projection model that produces these recommendations are presented in Table 1. The full 2019 catch was estimated by multiplying the partial 2019 catch by a correction factor based on the additional catch that occurred after October in the 5 previous years.

other skate harvest recommendations				
Quantity	As estimated or specified last year for:		As estimated or recommended this year for:	
	2019	2020	2020	2021
<i>M</i> (natural mortality rate)	0.1	0.1	0.1	0.1
Tier	5	5	5	5
Biomass (t)	119,787	119,787	119,787	119,787
F _{OFL}	0.10	0.10	0.10	0.10
maxF _{ABC}	0.075	0.075	0.075	0.075
F _{ABC}	0.075	0.075	0.075	0.075
OFL (t)	11,979	11,979	11,979	11,979
maxABC (t)	8,984	8,984	8,984	8,984
ABC (t)	8,984	8,984	8,984	8,984
Status	As determined <i>last</i> year for:		As determined <i>this</i> year for:	
	2017	2018	2018	2019
Overfishing	No	n/a	No	n/a

aggregate harvest recommendations for the BSAI complex				
Quantity	As estimated or specified <i>last</i> year for:		As estimated or recommended this year for:	
	2018	2019	2019	2020
OFL (t)	51,152	48,944	49,792	48,289
maxABC (t)	42,714	40,813	41,543	40,248
ABC (t)	42,714	40,813	41,543	40,248

SSC and Plan Team Comments on Assessments in General

There were no relevant general comments.

SSC and Plan Team Comments Specific to this Assessment

(These comments will be addressed in the next full assessment, scheduled for 2020.)

From the November 2018 Plan Team minutes:

- The Team suggested that the author review how other Tier 5 complexes deal with species with differing life histories when running the random effects models.
- The Team reiterated the request from the November 2016 minutes to “examine the utility of including IPHC and AFSC longline survey indices in both Model 14.2 and the random effects model for the Tier 5 species.”
- The Team requested that the author conduct sensitivity runs to examine potential biases in ageing.

From the December 2018 SSC minutes:

The SSC recommended that:

- The authors continue to explore the implications of using an RE model for collections of species with very different vital parameters
- Authors fill out/or update a stock-structure template for the skate complex

- Consideration be given to whether splitting Alaska skate out of the complex is warranted to avoid undue exploitation potential for other skate species
- Authors work to integrate IPHC longline data into future assessments

Tables

Table 1. Estimated catch of skates (t) in the Bering Sea and Aleutian Islands management area. “Official estimate” refers to the catch estimates as of October 26, 2019 maintained by the NMFS Alaska Regional Office in the Catch Accounting System. “Author’s species composition” refers to species-specific catch estimates for Alaska skates and the Other Skates group, calculated by the author based on species composition data from surveys and fisheries. Beginning with the 2007 values, a more reliable method that relies solely on observer data was used for estimating species composition of the skate catch.

Year	official estimate	author's species composition	
	total BSAI skate catch	Alaska skate catch	Other Skates catch
1992	16,962	15,299	1,663
1993	12,226	11,027	1,199
1994	14,223	12,829	1,394
1995	14,892	13,432	1,460
1996	12,643	11,403	1,240
1997	17,747	15,991	1,756
1998	19,318	17,278	2,040
1999	14,080	12,606	1,474
2000	18,877	16,417	2,460
2001	20,570	17,535	3,035
2002	21,279	19,514	1,765
2003	19,154	17,459	1,695
2004	22,329	20,199	2,130
2005	23,084	21,066	2,018
2006	20,250	18,254	1,996
2007	18,623	15,861	2,762
2008	21,677	15,698	5,979
2009	20,596	16,712	3,884
2010	17,726	13,114	4,613
2011	23,835	18,623	5,213
2012	24,827	19,523	5,304
2013	27,032	22,075	4,957
2014	27,599	21,233	6,367
2015	28,266	21,271	6,996
2016	29,197	23,142	6,055
2017	31,892	24,669	7,223
2018	31,207	24,139	7,068
2019*	17,611	13,622	3,989

* 2019 catch data are incomplete; data retrieved on October 26, 2019.

Table 2. Biomass estimates, 1999-2019, from the NMFS eastern Bering Sea (EBS) shelf bottom trawl survey for the major skate species found on the shelf (no survey was conducted for the EBS slope or Aleutian Islands during 2019). CV = coefficient of variation.

	big		Bering		Aleutian		Alaska	
	biomass	CV	biomass	CV	biomass	CV	biomass	CV
1999	6,492	1.00	9,404	0.20	0		323,240	0.17
2000	5,155	0.83	16,842	0.16	2,232	0.54	311,977	0.06
2001	1,811	0.78	14,263	0.14	1,232	0.61	414,539	0.06
2002	1,489	0.59	12,746	0.16	2,893	0.47	364,004	0.07
2003	0		13,602	0.12	18,253	0.43	372,379	0.05
2004	951	0.71	11,209	0.12	2,494	0.41	424,808	0.05
2005	2,307	0.71	8,774	0.17	8,223	0.56	487,046	0.05
2006	1,036	0.68	11,674	0.13	5,568	0.41	437,737	0.05
2007	1,804	0.76	9,480	0.14	2,718	0.43	479,043	0.07
2008	2,870	0.63	9,943	0.16	6,278	0.57	361,300	0.06
2009	4,500	0.50	13,274	0.18	2,171	0.49	350,233	0.06
2010	3,445	0.66	11,992	0.14	3,332	0.35	366,186	0.06
2011	5,263	0.72	9,795	0.17	2,525	0.54	410,340	0.05
2012	1,161	0.70	10,190	0.16	4,565	0.37	369,881	0.06
2013	3,379	1.00	12,099	0.28	11,483	0.35	386,816	0.06
2014	3,596	0.60	12,570	0.15	8,149	0.41	404,380	0.05
2015	15,438	0.49	12,210	0.13	11,084	0.40	448,224	0.06
2016	10,668	0.54	10,981	0.12	14,449	0.27	550,892	0.04
2017	13,716	0.41	15,249	0.17	36,900	0.56	544,657	0.07
2018	28,731	0.42	14,564	0.11	18,922	0.33	545,994	0.05
2019	11,847	0.37	10,091	0.12	14,899	0.27	491,109	0.05

Table 3. Survey biomass estimates (t) of Alaska skate in the northern Bering Sea, 2010-2019. Estimates are from the northern Bering Sea bottom trawl survey that extends north from the historical eastern Bering Sea shelf survey area. CV = coefficient of variation.

	biomass	CV
2010	76,942	0.19
2017	81,305	0.14
2019	95,102	0.15

Figures

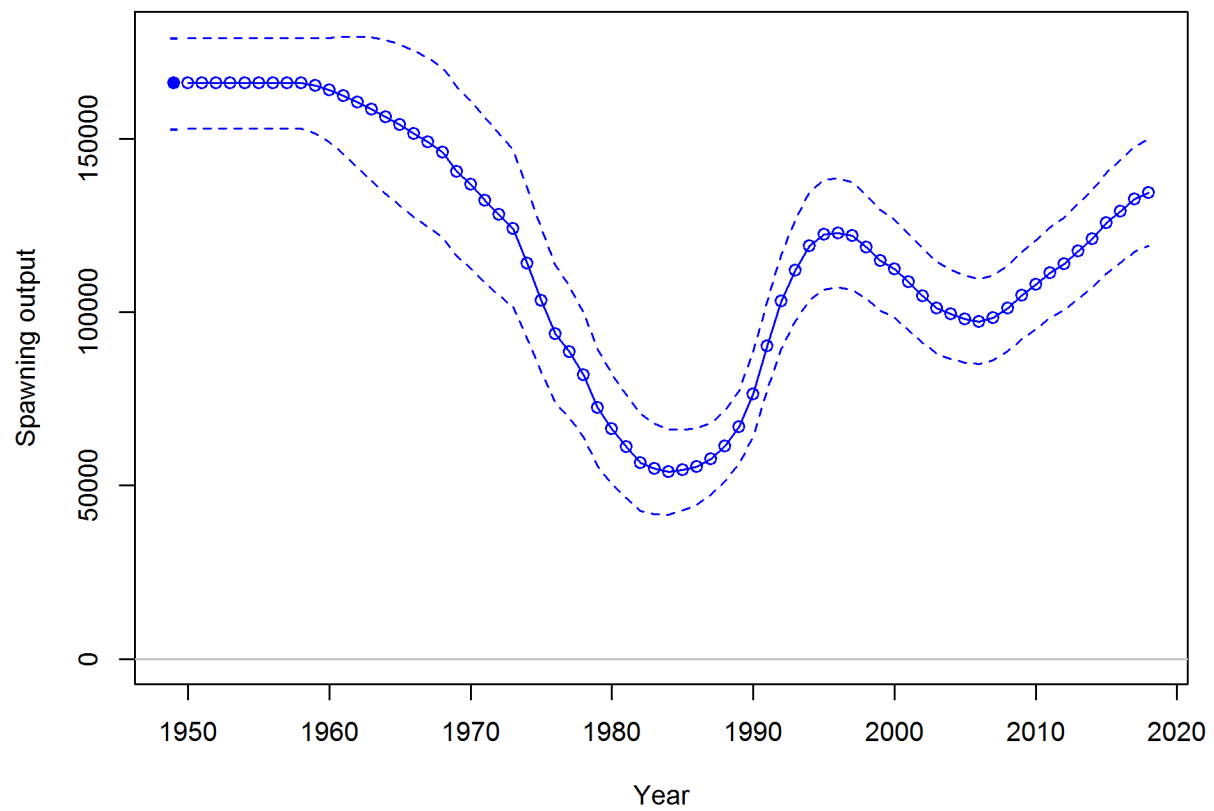


Figure 1. Model estimates of total Alaska skate biomass, 1950-2018. Error bars indicate 95% confidence interval. Results are from an age-structured model described in the 2018 Bering Sea and Aleutian Islands stock assessment (<https://www.afsc.noaa.gov/REFM/Docs/2018/BSAIskate.pdf>).

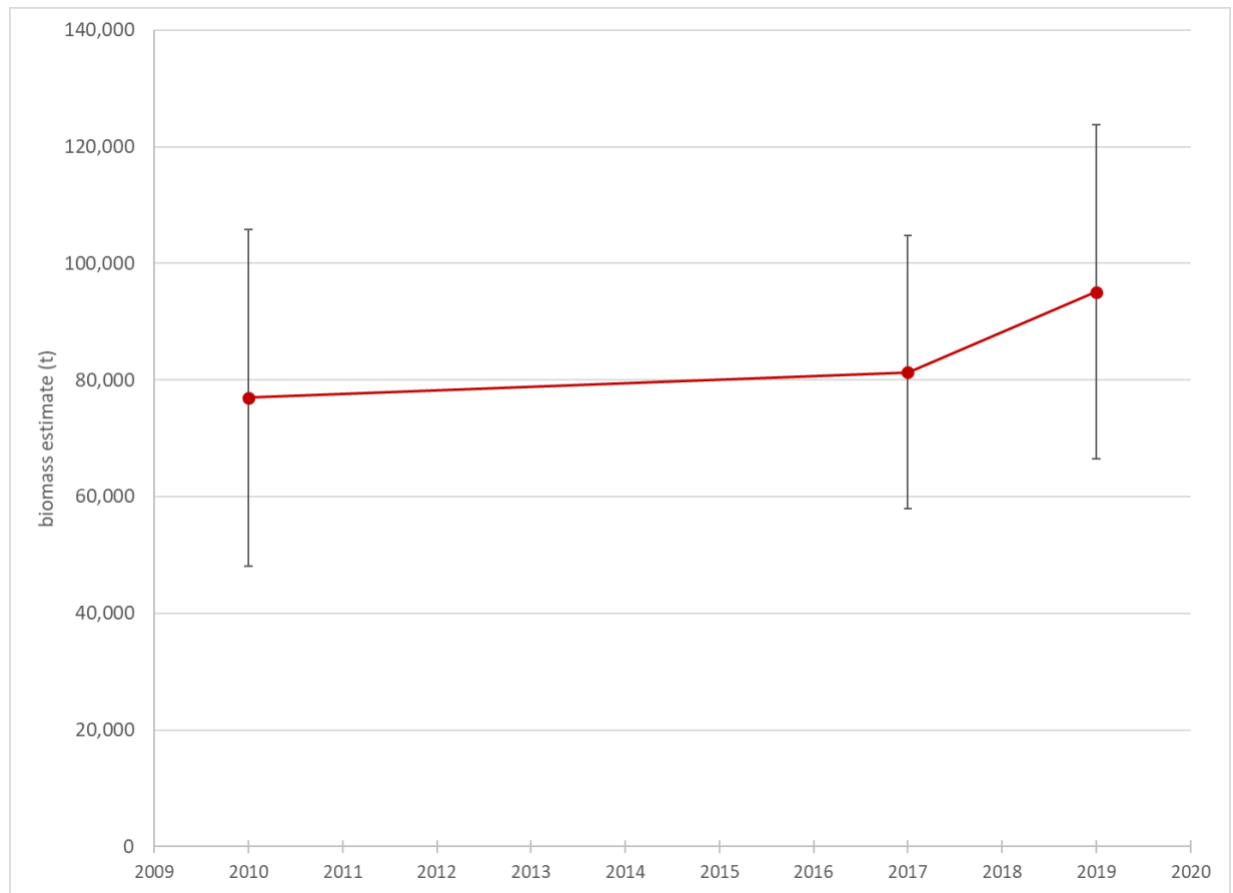


Figure 2. Survey biomass estimates (t) of Alaska skate in the northern Bering Sea, 2010-2019. Estimates are from the northern Bering Sea bottom trawl survey that extends north from the historical eastern Bering Sea shelf survey area.

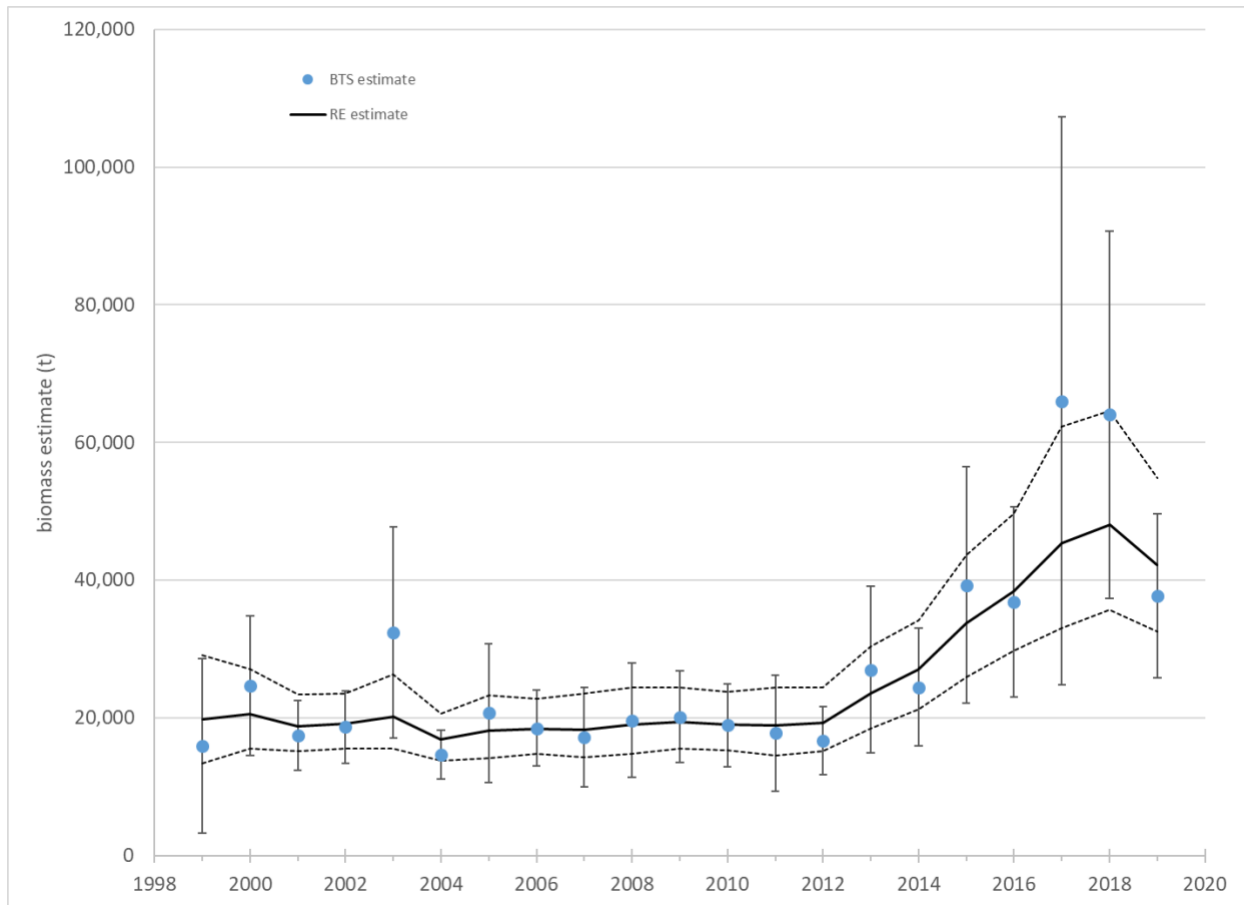


Figure 3. Biomass estimates, 1999-2019, of the Other Skates group (i.e. all skate species except Alaska skate) on the eastern Bering Sea (EBS) shelf. Values shown include raw estimates from the NMFS EBS bottom trawl survey (BTS) and estimates from a random-effects (RE) model fitted to the raw estimates. The 95% confidence intervals are indicated by dashed lines (RE estimate) or error bars (BTS estimate). A full description of the random-effects model can be found in the 2018 Bering Sea and Aleutian Islands stock assessment (<https://www.afsc.noaa.gov/REFM/Docs/2018/BSAIskate.pdf>). The other relevant surveys for skates (Aleutian Islands and EBS slope bottom trawl surveys) are conducted in even years, so no new data are available.

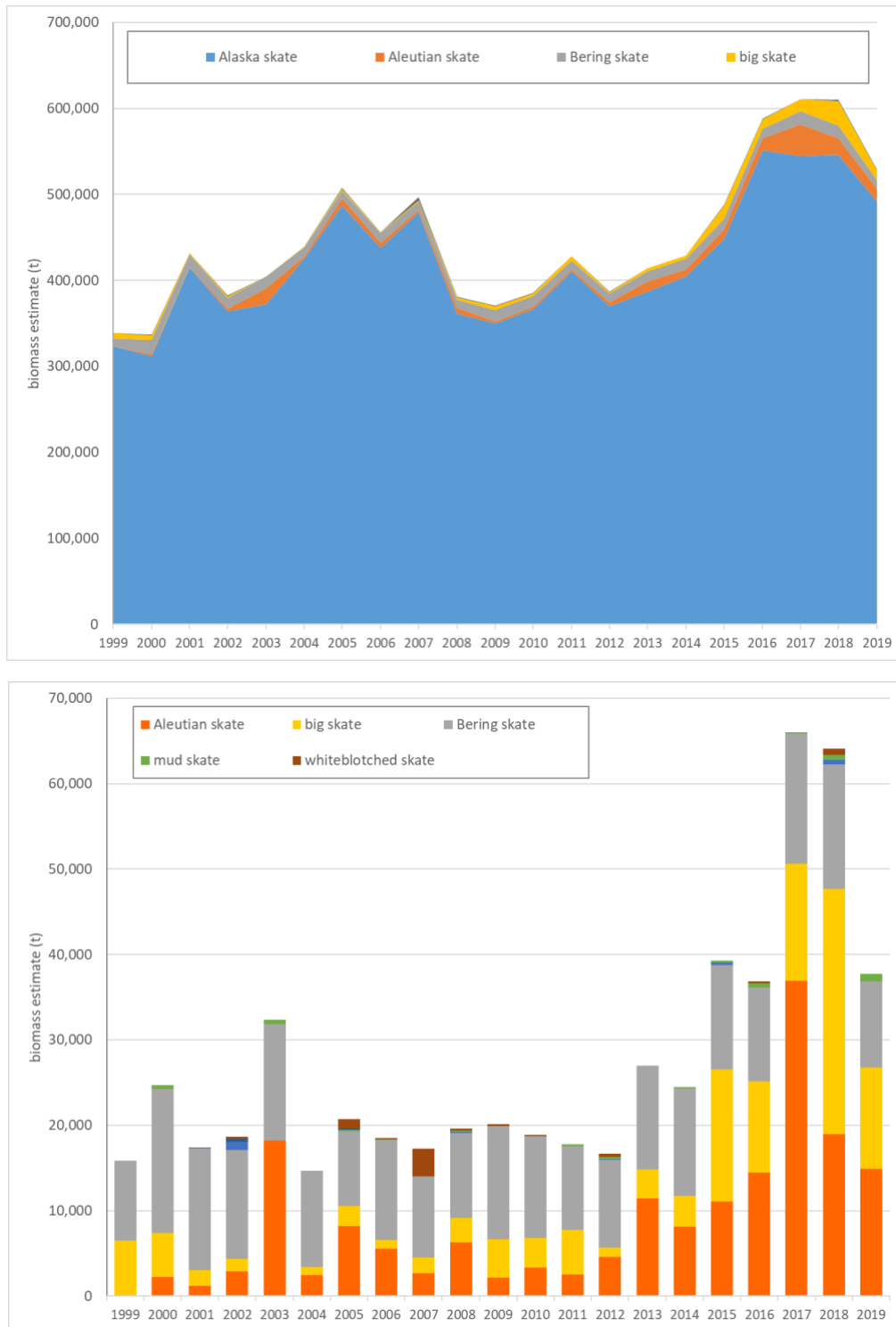


Figure 4. Species composition of survey biomass estimates for skates on the eastern Bering Sea shelf (EBS) by year from 1999-2019. Total biomass (t) is displayed for the assemblage either with (top) or without (bottom) Alaska skate, which is the dominant species. Data are from the NMFS EBS shelf bottom trawl survey; vertical scales differ between plots.

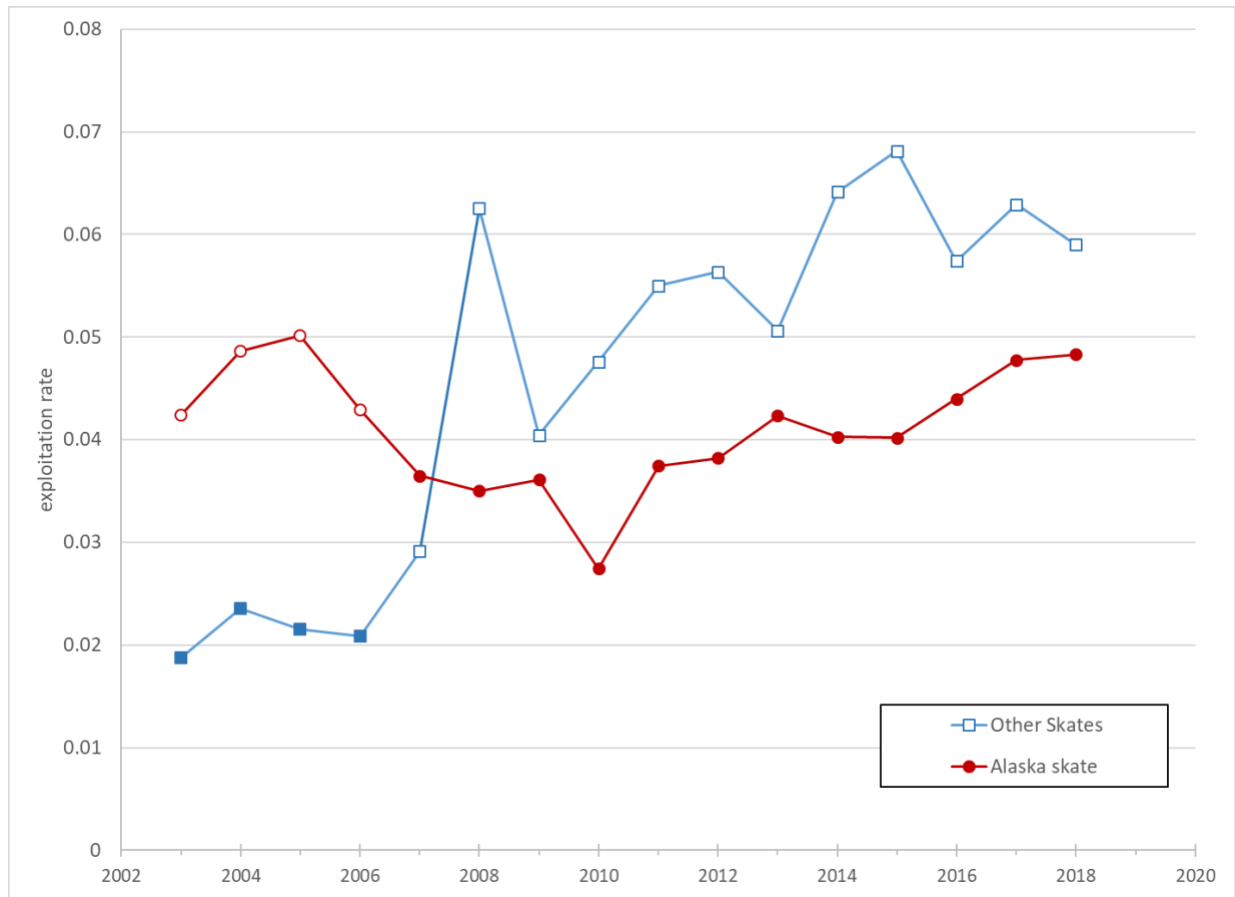


Figure 5. Exploitation rates (total catch/total biomass) for Alaska skate and the Other Skates group in the Bering Sea and Aleutian Islands regions (BSAI), 2003-2018. For both groups, catch data are the author's estimate described in Table 1. For Alaska skate, biomass is the model-predicted total biomass described in Figure 1. For Other Skates, biomass is a combination of three separate random-effects models for each of the three BSAI surveys (eastern Bering Sea (EBS) shelf, EBS slope, and AI). Beginning with the 2007 values, a more reliable method was used for estimating species composition of the skate catch. Full description of the random-effects model can be found in the 2016 Bering Sea and Aleutian Islands stock assessment (<https://www.afsc.noaa.gov/REFM/Docs/2016/BSAIs skate.pdf>).